



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/713,762	11/13/2003	Yang Chin Cheng	MXIC-P910284	3582

7590 02/21/2006

Kenton R. Mullins
Stout, Uxa, Buyan & Mullins, LLP
Suite 300
4 Venture
Irvine, CA 92618

EXAMINER

PHAM, THANHHA S

ART UNIT	PAPER NUMBER
----------	--------------

2813

DATE MAILED: 02/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/713,762

Applicant(s)

CHENG, YANG CHIN

Examiner

Thanhha Pham

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,7-12,17-19,21-24 and 27-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,7-12,17-19,21-24 and 27-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office Action is in response to Applicant's Amendment dated 12/05/2006.

Oath/Declaration

1. Oath/Declaration filed on 11/13/2003 has been acknowledged.

Specification

2. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: Specification is needed to correct to support limitation of original claim 28 of removing the patterned photoresist by ozone plasma.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 24 and 28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

► With respect to claim 24, "removing the second portion of the silylated layer is terminated before a substantially portion of the substrate is removed" renders the claim indefinite since the term of "before a substantially portion of the substrate is removed".

It is not clear that whether or not a substantially portion of the substrate is removed.

Notice that the claim does not positively recite limitation of “removing a substantially portion of the substrate”

► With respect to claim 28, it is not clear how “the removing of the second portion of the silylated layer can be terminated before a substantial portion of the material is removed” while the substantially portion of the material was previously removed using the silylated layer as an etch mask.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-2, 7, 10-11, 17-18, 21, 23-24 and 29 are rejected under 35

U.S.C. 102(b) as being anticipated by Liao [US 6,294,314].

► With respect to claims 1-2, 7, 10-12 and 29, Liao (figs 1A-1D, cols 1-3) discloses a method for forming a semiconductor device comprising:

providing a substrate (100, fig 1A);

forming a material layer (104, fig 1A, col 2 lines 4-15) over the substrate, wherein the material layer is selected from a group consisting of silicon, silicon dioxide, doped silicon dioxide, silicon nitride, poly silicon, aluminum, copper, titanium, titanium nitride, tantalum, and tantalum nitride;

forming a photoresist layer (106, fig 1A, col 2 lines 4-15) over the material layer, the photoresist layer is a patterned photoresist layer;

exposing a top surface of the photoresist layer to a treatment radiation, the treatment radiation comprises light radiation, the exposing of the photoresist layer to radiation comprises performing a flood exposure process to alter at least one property of the photoresist layer (col 2 lines 9-15: *short wavelength of deep ultraviolet light to develop the photoresist layer would inherently perform a flood exposure process to alter at least one property of the photoresist layer 106*) ;

forming a protectant layer (110, fig 1B, col 2 lines 16-55) over the photoresist layer, protectant layer comprises a silylated layer, wherein the exposing of the photoresist layer to radiation comprises performing a flood exposure process to alter at least one property of the photoresist layer ;

removing a portion of the protectant layer to expose an underlying portion of the photoresist layer (fig 1B-1C);

removing the photoresist layer (fig 1C-1D);

removing portions of the material layer (104, figs 1B-1C) using the protectant layer as a mask; and

removing another portion (110a) of the protectant layer.

► With respect to claims 17-18, 21, and 23-24, Liao (figs 1A-1D, cols 1-3) discloses a method comprising:

providing a substrate (100, fig 1A, col 2 lines 4-15) having a first layer (104) formed thereon;

Art Unit: 2813

forming a second layer (106, fig 1A, col 2 lines 4-15) on the first layer;

performing a treatment on and forming a protection layer (110, fig 1B, col 2 lines 4-43) over the second layer, the treatment comprises a flood exposure (col 2 lines 12-15: *short wavelength of deep ultraviolet light to develop the photoresist layer 106 would inherently perform a flood exposure*), the protective layer comprises a silylated layer;

removing a first portion of the protection layer (110) to expose the second layer (fig 1B-1C), the removing the first portion of the silylated layer (110) to expose the second layer (106, fig 1B-1C) comprises using an etching back/dry etching process or a chemical mechanical planarization/wet etching process (figs 1B-1C, col 2 lines 16-55: *a first portion of the silylated layer 110 is removed by dry etching process/etching back process*), the removing of the first portion of the silylated layer is terminated before substantially portion of the second layer is removed ;

removing the second layer (106, fig 1C-1D), the removing of the second layer comprises inherently using a dry stripping process or a wet stripping process,

using the protection layer as an etch mask, removing an exposed portion of the first layer (fig 1B-1C, col 2 lines 16-55); and

removing a second portion of the protection layer (110a, fig 1C-1D, col 2 lines 14-60), the removing of the second portion of the silylated layer forms a plurality of structures having a pitch that is smaller than a photolithography process will allow (col 3 lines 3-10).

Notice: with respect to claim 24, limitation "before a substantially portion of the substrate is removed" does not carried a patent weight since limitation of "removing a substantially portion of the substrate" does not exist.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 12 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liao [US 6,294,314] in view of Mimura et al [US 4,751,170].

Liao substantially discloses the claimed method including forming the second layer of a patterned photoresist, performing a treatment using ultraviolet radiation on and forming a protection layer of a silylated layer over the second layer so that a top surface of second layer is exposed to the ultraviolet radiation.

Liao is silent about using the ultraviolet radiation substantially perpendicularly to the second layer of patterned photoresist and silylanizing the photoresist layer being performed in a gas phase.

However using the ultraviolet radiation substantially perpendicularly to the second layer of patterned photoresist so that a top surface of the second layer of patterned photoresist being exposed to the ultraviolet radiation and silylanizing the photoresist layer in gas phase are known technique for treating and silylanizing the

photoresist. See Mimura et al (fig 2, cols 1-14 more particularly col 12 lines 8-30) shows treating the patterned photoresist by using the ultraviolet radiation substantially perpendicularly to the patterned photoresist so that the top surface of the patterned photoresist being exposed to the ultraviolet radiation and silylanizing the photoresist layer in gas phase.

Therefore, at the time of invention, it would have been obvious for those skilled in the art to modify process Liao et al by treating the patterned photoresist and silylanizing the patterned photoresist as being claimed as known techniques per taught by Mimura et al to provide the silylated layer on the patterned photoresist for forming structure with reduced pitch as demanded in device.

7. Claims 1-2, 7, 10-12, 17-18, 21-24, 27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Maimon et al [US 6,589,714] in view of McColgin et al [US 4,931,351].

Maimon et al (figs 1-8, cols 1-17) discloses a method for forming a semiconductor device having a reduced pitch, the method comprising:

forming a material layer/a first layer (130a/130b, fig 2f's, col 6 lines 47-6, col 7 lines 1-67) on a substrate (102);

forming a patterned photoresist layer/a second layer (240, fig 2G's, col 8 lines 1-12) on the material layer/the first layer;

silylanizing the patterned photoresist layer/the second layer in a gas phase or in a liquid phase by diffusing silylamine into the patterned photoresist layer/the second

layer and forming a silylated layer (252/254, fig 2H, col 8 lines 13-30) over the surface of the patterned photoresist layer/the second layer (240);

removing a first portion of the silylated layer (252, fig 2I, col 8 lines 31-36) to expose the patterned photoresist layer/the second layer using an etching back process or a chemical mechanical planarization process (fig 2H-2I), the removing of the first portion of silylated layer is terminated before a substantially portion of the patterned photoresist layer (240)/ the second layer is removed;

removing the patterned photoresist layer/ the second layer using a plasma gas (fig 2J's, col 8 lines 38-47), the removing the patterned photoresist layer/the second layer is terminated before a substantially portion of the material layer/the first layer is removed;

using the silylated layer (264, fig 2J's-2K's, col 8 lines 37-67 & col 9 lines 1-4) as an etch mask, removing an exposed portion of the material layer (103a,b);

removing a second portion of the silylated layer (264, figs 2K's-2M) to form a plurality of structures (protrusion 135) having a pitch that is smaller than a photolithography process will allow.

Mainon et al does not expressly teach exposing the patterned photoresist layer/the second layer to ultraviolet radiation to alter at least one property of the patterned photoresist layer so that a cross-link degree of a portion of the patterned photoresist layer/the second layer is reduced. Mainon et al is also silent about silylanizing the patterned photoresist layer comprising silylanizing of a surface of the patterned photoresist layer by a silylation process being performed in a gas phase.

However, McColgin et al (cols 1-7) teaches exposing the patterned photoresist layer to ultraviolet radiation to alter at least one property of the patterned photoresist layer for improving silylanizing the photoresist pattern in gas phase (col 4 lines 23-68 and col 5 lines 1-30).

Therefore, at the time of invention, it would have been obvious for those skilled in the art to modify process Maimon et al by exposing the patterned photoresist layer to ultraviolet radiation to alter at least one property of the patterned photoresist layer as as taught by McColgin et al for improving silylanizing the patterned photoresist in gas phase as being claimed. Since McColgin et al teaches exposing the patterned photoresist to UV will enhance silicon uptake prior to contacting the patterned photoresist with silicon-containing compound for silylanizing process, those skilled in the art would recognize that the UV radiation would reduce a cross-link degree of a portion the patterned photoresist (for silylanizing process's enhance) in the combination process of Maimon et al in view of McColgin et al. "[T]he discovery of a previously unappreciated property of a prior art composition, or of a scientific explanation for the prior art's functioning, does not render the old composition patentably new to the discoverer." *Atlas Powder Co. v. Ireco Inc.*, 190 F.3d 1342, 1347, 51 USPQ2d 1943, 1947 (Fed. Cir. 1999). Thus the claiming of a new use, new function or unknown property which is inherently present in the prior art does not necessarily make the claim patentable. *In re Best*, 562 F.2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977). The court stated that "just as the discovery of properties of a known material does not make

it novel, the identification and characterization of a prior art material also does not make it novel."

8. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Maimon et al [US 6,589,714] and McColgin et al [US 4,931,351] in further view of Mimura et al [US 4,751,170].

Maimon et al in view of McColgin et al substantially discloses the claimed method including performing a treatment using ultraviolet radiation on and forming a protection layer of a silylated layer over the patterned photoresist layer/ the second layer so that a top surface of the patterned photoresist layer / the second layer is exposed to the ultraviolet radiation.

Maimon et al in view of McColgin et al is silent about using the ultraviolet radiation substantially perpendicularly to the second layer of patterned photoresist .

However using the ultraviolet radiation substantially perpendicularly to the second layer of patterned photoresist so that a top surface of the second layer of patterned photoresist being exposed to the ultraviolet radiation is a technique for treating and silylanizing the patterned photoresist. See Mimura et al (fig 2, cols 1-14 more particularly col 12 lines 8-30) shows treating the patterned photoresist by using the ultraviolet radiation substantially perpendicularly to the patterned photoresist so that the top surface of the patterned photoresist being exposed to the ultraviolet radiation for silylanizing process.

Therefore, at the time of invention, it would have been obvious for those skilled in the art to modify process Maimon et al in view of McColgin et al by using the UV

Art Unit: 2813

radiation perpendicularly to the patterned photoresist and silylating the patterned photoresist as being claimed as known techniques per taught by Mimura et al to provide the silylated layer on the patterned photoresist for forming structure with reduced pitch as demanded in device.

9. Claims 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liao [US 6,294,314] OR over Maimon et al [US 6,589,714] in view of McColgin et al [US 4,931,351], in further view of Merritt et al [US 2001/0049071] or Odaka et al [US 2003/0224560]

► With respect to claims 8-9, positive e-beam photoresist is a known photoresist material for forming mask in photolithography process to fabricate semiconductor device. See Odaka et al and Merritt et al as evidences that shows using the positive e-beam photoresist for forming a mask in photolithography process. Therefore, at the time of invention, it would have been obvious for those skilled in the art, in view of Merritt et al [US 2001/0049071] or Odaka et al [US 2003/0224560], to use the positive e-beam photoresist as a known material to form as mask in the process of either Liao or Maimon et al in view of McColgin for patterning process to form the semiconductor device. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a

known plastic to make a container of a type made of plastics prior to the invention was held to be obvious).

10. Claim 28, as being best understood, is rejected under 35 U.S.C. 103(a) as being unpatentable over Maimon et al [US 6,589,714] in view of McColgin et al [US 4,931,351], in further view of Chooi et al [US 6,350,675].

► With respect to claim 28, ozone is a known material for removing the patterned photoresist. See Chooi et al as an evidence that shows using ozone plasma for removing the patterned photoresist. Therefore, at the time of invention, it would have been obvious for those skilled in the art, in view of Chooi et al, to use ozone plasma to remove the patterned photoresist layer Maimon et al in view of McColgin. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious).

Conclusion

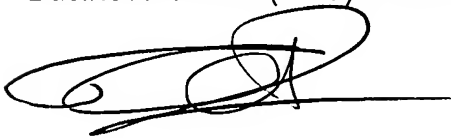
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-

Art Unit: 2813

1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Thanhha Pham', with a horizontal line extending to the right.

Thanhha Pham